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MECHANISMS OF SLUDGE THICKENING

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SEPARATE PROGRESS REPORT

to Accompany

APPLICATION FOR CONTINUATION SUPPORT

for

WP01011-03

MECHANISMS OF SLUDGE THICKENING

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SEPARATE PROGRESS REPORT

Mechanisms of Sludge Thickening

The course of the study has followed the ~~basic~~ plan described in ~~the~~ initial proposal. Emphasis ~~during the 01 and 02 years~~ has been directed toward study of the basic mechanisms involved in thickening and ~~of~~ the feasibility of altering, or taking advantage of, the basic properties of suspensions to improve their thickening characteristics. Emphasis during the remainder of the 02 year and during the 03 year will be directed toward extension and application of the basic findings through laboratory studies of larger scale continuous thickeners and field studies of full scale thickeners.

A fruitful phase of the fundamental portion of the study involving the use of concepts ~~of~~ flow through porous media in interpreting thickening behavior has recently been completed. By use of this technique, it has been possible to observe changes in particle size and water content as thickening progresses. The results of this work will be presented to the profession at the Annual Water Pollution Control Federation Conference in September 1968. In another phase of the fundamental studies, the relative significance of interparticle forces and of fluid forces during subsidence of water softening sludges was investigated by means of excess hydrostatic pressure measurements. Developmental work on an improved viscometer to measure the basic physical properties of activated sludge was completed and the instrument was used in a study of the influence of operational variables on the physical behavior of activated sludge. This work is being summarized in a Master's degree thesis by S. K. Chakarbarti and it is anticipated that it will be reported in the form of a paper during the next year. Studies of the alteration of sludge thickening characteristics by use of ultrasonic vibrations and polymers were concluded during the past year. In addition to providing an appreciation of the feasibility of these methods, the studies gave insight into the mechanisms involved in thickening. A brief study on the feasibility of increasing the thickening rate of charged particles by means of an electrical field was also carried out during the past year.

Currently, efforts are being directed toward field studies of full scale thickeners. An instrument, critical for these studies, is under development. It is a sensor for <u>in situ</u> determination of suspended solids concentrations in settling basins. The device makes use of the change in the dielectric constant of a suspension brought about by the presence of solids to sense suspended solids concentrations. When perfected, the solid sensing instrument will be used to determine suspended solids profiles at various locations in full scale settling basins. To further assist the study of the application of fundamental thickening concepts to operational continuous thickeners, a continuous flow laboratory thickener is being constructed. It will be used in carefully controlled tests to assist in interpreting the

data from full scale thickeners in terms of fundamental concepts of thickening to permit development of more rational bases for design.

The following publications have been prepared to describe phases of the work in more detail. Copies of all are available.

COMPLETED

Dick, R. I. and Ewing, B. B., The Rheology of Activated Sludge, Journal of the Water Pollution Control Federation, 39:543-560 (April 1967).

Wang, R.C.T., A Viscometer for the Study of the Rheology of Activated Sludge, Unpublished Special Project Report, 25 pp. (June 1967).

Dick, R. I. and Ewing, B. B., Evaluation of Activated Sludge Thickening Theories, Journal Sanitary Engineering Division American Society of Civil Engineers, 93, SA4, 9-29 (Aug. 1967).

Farnsworth, G. A., The Effect of Induced Flocculation on the Settling and Thickening Behavior of Activated Sludge, Civil Engineering Studies, Sanitary Engineering Series No. 42, 54 pp. (Aug. 1967).

Wallin, T. R., "The Influence of Ultrasonic Vibrations Upon the Physical Features of Activated Sludge." Civil Engineering Studies, Sanitary Engineering Series No. 43, 101 pp. (Nov. 1967).

Dick, R. I., Discussion of Settling of Activated Sludge in Horizontal Tanks by C.N.H. Fisherstrom, E. Isgard, and I. Larsen, Journal Sanitary Engineering Division American Society of Civil Engineers, 93, SA6, 271-273 (Dec. 1967).

Babb, A. C., An Instrument for the Determination of Sludge Density, Unpublished Special Project Report, 11 pp. (Jan. 1968).

Gain, W. R., Electrically Induced Settling of Activated Sludge, Unpublished Special Project Report, 29 pp. (Feb. 1968).

PENDING

Chakrabarti, S. K., Changes in Some Physical Properties of Activated Sludge Under Different Biological Loading Conditions, Civil Engineering Studies, Sanitary Engineering Series No. 47, 65 pp. (In Press) (June 1968).

Dick, R. I., Theoretical Aspects of Treatment by Sedimentation and Flotation, The Digester, (Submitted for Publication).

Dick, R. I., Thickening Characteristics of Activated Sludge. Advances in Water Pollution Research, Proceedings of Fourth International Conference on Water Pollution Research to be held in Prague, Czechoslovakia, September 1968.

Dick, R. I., Discussion of Sedimentation of Activated Sludge in Final Settling Tanks by P. Pflanz. Advances in Water Pollution Research, Proceedings of Fourth International Conference on Water Pollution Research to be held in Prague, Czechoslovakia, September, 1968.

Narang, B. S., A Generalized Solution of the Boltzman Equation, Physics of Fluids, (Submitted for publication).

Dick, R. I., Some Fundamental Aspects of Sedimentation, Water and Wastes Engineering, (Submitted for publication).

Gratteau, J. C. and Dick, R. I., Activated Sludge Suspended Solids Determinations, Water and Sewage Works, (Submitted for publication).

Javaheri, A. R. and Dick, R. I., Fluid Displacement and Particle Size Variations During Thickening of Activated Sludge, Journal Water Pollution Control Federation, (Selected for presentation at 41st Annual Conference of the Federation, September 1968).